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WATER QUALITY SURVEY
OF
LAKE OF BAYS

December, 1981

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WATER QUALITY SURVEY OF LAKE OF BAYS IN THE DISTRICT MUNICIPALITY OF MUSKOKA AND THE PROVISIONAL COUNTY OF HALIBURTON

Field Survey: 1978

Report: 1981

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INTRODUCTION

In 1978, the Ministries of Natural Resources and Environment conducted a joint water quality survey of Lake of Bays. The lake's importance, both as a lake trout fishery, and as a recreational lake, warranted this study, as no comprehensive water quality assessment had previously been conducted on this lake.

DESCRIPTION OF STUDY AREA

Lake of Bays is located approximately 26 kilometres northwest of Bracebridge, in the Township of Sherborne, Provisional County of Haliburton and in the Township of Lake of Bays, District Municipality of Muskoka. Lake of Bays has a complex shoreline composed of numerous bays and inlets (Figure 1).

Lake of Bays is located on the Precambrian Shield, which is characterized by granitic bedrock, with a thin overburden of sandy loam. It's watershed is predominantly forested, with many surrounding lakes. The terrain is hilly and rolling.

The physical characteristics of Lake of Bays were obtained from the Ministry of Natural Resources and are summarized below:

Surface Area	70.53 km^2 (17,428 acres)
Drainage Basin Area	1481.48 km^2 (365,851 acres)
Maximum Depth	70.10 m. (230 ft.)
Mean Depth	22.25 m. (73 ft.)
Volume	1567.67 x 10^6 m^3 (1,270,809 acre ft.)

Lake of Bays has an extensive watershed with two major inflowing rivers: the Oxtongue River and the Hollow River.

The Oxtongue River system, which flows into Dwight Bay, drains an area northeast of Lake of Bays, extending into Algonquin Park. The largest lakes in this system are Canoe, Burnt Island, and Smoke.

The Hollow River system drains an area east of Lake of Bays and flows into Trading Bay. Kawagama Lake is the largest lake in this drainage system. There are numerous small creeks and streams which also flow into Lake of Bays.

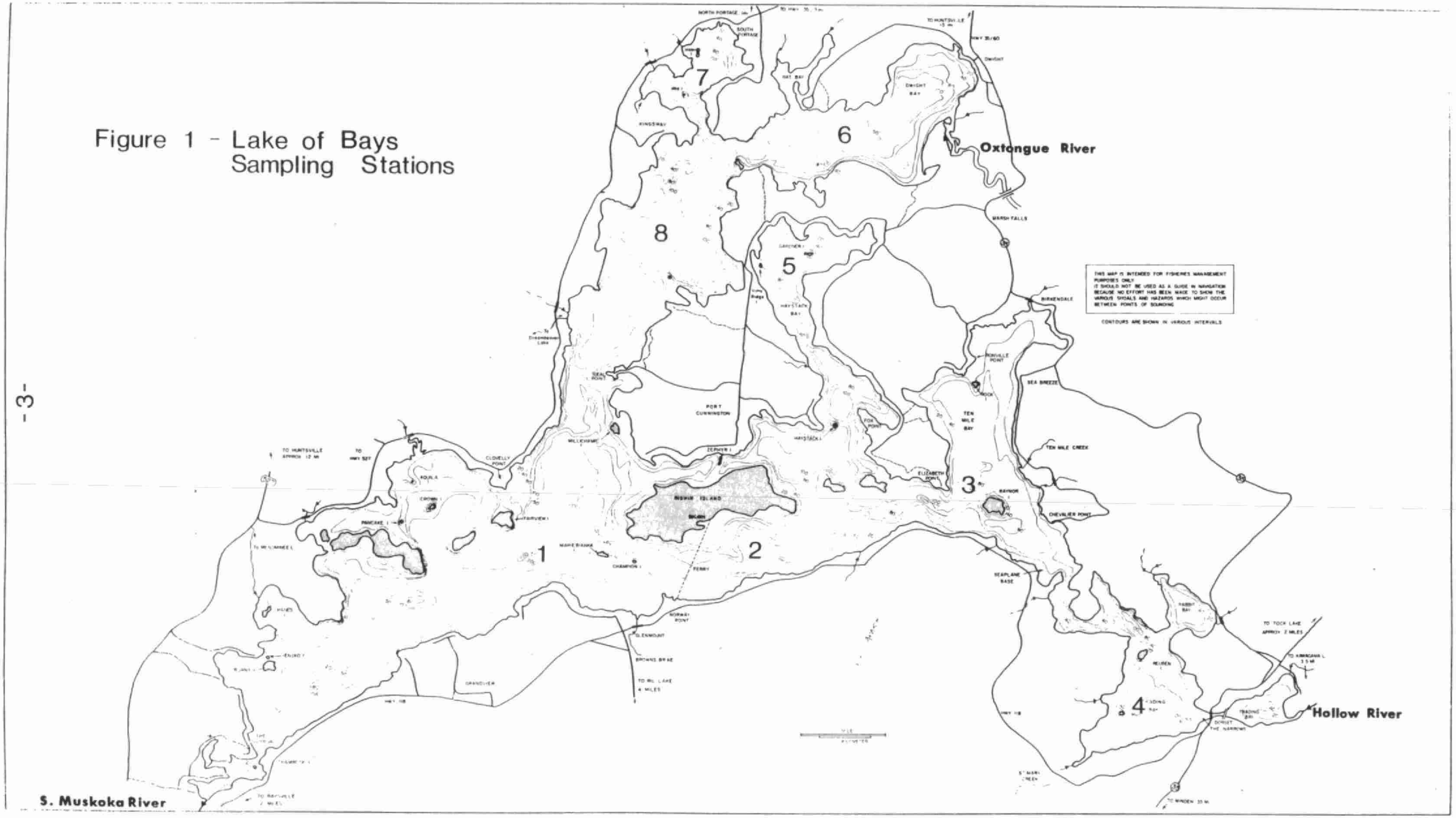
Lake of Bays is the headwater of the South Branch of the Muskoka River, which exits from the extreme, southwestern end of the lake at Baysville. The North and South Branches of the Muskoka River join in Bracebridge to become the Muskoka River, which flows into Lake Muskoka and eventually drains into Georgian Bay.

There is a stoplog dam on the outflow of Lake of Bays which is operated by the Ministry of Natural Resources in order to regulate water levels in Lake of Bays. When levels are high, excess water is allowed to flow from the lake for use in power generation downstream by Orillia Water, Light and Power and Ontario Hydro. The average yearly outflow from Lake of Bays is 7.0×10^8 m^3(1).

Present Development

The following is a summary of development and access on Lake of Bays as obtained from the Ministry of Natural Resources, Lakeshore Capacity Study, Degree of Development and Resource Capacity-1978 (unpublished data).

Figure 1 - Lake of Bays Sampling Stations



# of Cottages	1,595
# of Resorts	23 (capacity-2,063 people)*
# of Vacant, Registered, Shoreline Lots	619
# of Public Access Points	9 municipal; 1 provincial
% of Crown Land	0

*None of these resorts have sewage facilities discharging to Lake of Bays.

Fisheries

The main sports fish species in Lake of Bays are lake trout, smallmouth bass, and lake whitefish. Lake of Bays is one of the most important lake trout lakes in the District Municipality of Muskoka.

The Ministry of Natural Resources conducts a lake trout stocking program in Lake of Bays. The following are stocking figures for the period of 1977 to 1980:

Year	Age Class of Stocked Fish	Number of Lake Trout Stocked
1977	2 year	3,225
1978	2 year	3,221
1979	1 year	5,500
1980	4 year	1,600

SURVEY PROCEDURES

Eight sampling stations were established in the centre of the lake's major basins (Figure 1). These stations were visited on seven occasions between May 10, 1978 and September 20, 1978. During each visit, the following samples and measurements were obtained:

(i) The degree of water transparency was measured using a Secchi disc.

(ii) Euphotic zone* composite sample (taken through a depth of water equal to twice the Secchi disc reading) to be analyzed for:

- (a) chlorophyll _a_ concentration, which indicates the density of suspended algae in the water sampled;
- (b) phytoplankton cell volume, which indicates the biomass of phytoplankton present in the water sampled. These samples were taken throughout the sampling period and then recombined volumetrically so that one sample per station was obtained that was representative of the average composition of the phytoplankton community throughout the sampling period.
- (c) The following chemical parameters:

Total Phosphorus (T. Phos.)
Total Kjeldahl Nitrogen (TKN)
Free Ammonia (NH_3)
Nitrite (NO_2)
Nitrate (NO_3)
Conductivity (Cond.)

(iii) Bottom water sample taken from two metres above the bottom using a Van Dorn sampler to be analyzed for the same chemical parameters listed in (ii)(c).

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*The euphotic zone is the surface layer of a lake which receives sufficient light to support the growth of phytoplankton.

(iv) Temperature profile measured at every metre through the water column.

(v) Dissolved oxygen concentration of water samples taken at one metre below the surface, mid-depth, five metres above the bottom, and one metre above the bottom. Dissolved oxygen determinations were conducted in the field using the Azide modification of the Winkler method.

Additionally, on the first and last visit, a euphotic zone composite sample and a bottom water sample were obtained for the following analyses:

Alkalinity (Total Fixed Endpoint)
Hardness
Conductivity
Chloride (Cl^-),
Sodium (Na^+)
Potassium (K^+)
Calcium (Ca^{++})
Sulphate (SO_4^{--})
Magnesium (Mg^{++})
Total Carbon (TC)
Total Organic Carbon (TOC)
Total Inorganic Carbon (TIC).

Chemical analyses were performed at the Ministry of the Environment Laboratory in Rexdale. Analyses results (Tables 1-18) and dissolved oxygen and temperature data (Figures 4-11) are summarized in the Appendix.

WATER QUALITY

The status of a lake's water quality is often referred to in terms of enrichment status. Enrichment of lakes occurs when fertilizing nutrients, such as nitrogen and phosphorus, enter the lake via rainfall, runoff from land and shoreline development activities. These nutrients promote the growth of aquatic plants and algae. It is important to realize that small to moderate amounts of aquatic plants and algae are necessary to provide food for aquatic invertebrate organisms which, in turn, provide food for fish. Too much growth, however, may interfere with water-oriented, recreational activities.

Previous experience indicates that there are three general categories of lake enrichment: enriched, moderately enriched and unenriched. All three categories exist in nature, however, man's activities can alter a lake's enrichment status. The enrichment status of a lake is determined by the transparency of the water, indicated by Secchi disc readings and by the density of suspended, microscopic aquatic plants called algae or phytoplankton, indicated by chlorophyll a concentrations.

Figure 2 illustrates the relationship between Secchi disc readings and chlorophyll a concentrations for a range of lakes varying from enriched to unenriched. Enriched lakes, such as Lake St. John, have high concentrations of nutrients and are characterized by excessive growths of algae and aquatic weeds. These may interfere with recreational activities such as swimming and boating. As a result of the large amount of algae suspended in the water, sunlight is not readily transmitted and the degree of water transparency is low. Secchi disc readings in enriched lakes are generally less than three metres and chlorophyll a concentrations are 4 ug/L or greater. Enriched lakes are generally not desirable from a recreational standpoint.

Unenriched lakes, such as Lake of Bays (Figure 2), are usually clear water lakes with low concentrations of nutrients. Secchi disc readings are five metres or greater due to the high degree of water transparency. Chlorophyll a concentrations are less than 2 ug/L due to the low densities of suspended algae or phytoplankton in the euphotic zone. Unenriched lakes are very desirable from a recreational standpoint.

Moderately enriched lakes such as Boshkung Lake and Muldrew Lake (Figure 2), are intermediate between enriched and unenriched lakes. These lakes are usually suitable for recreational activities, however, periodic problems such as algae blooms may occur.

The Self-Help Programme was initiated in 1971 in response to requests from concerned cottagers for water quality information on many recreational lakes throughout the province. Cottagers take Secchi disc readings and collect water samples for chlorophyll a analysis bi-weekly during the ice-free period. The results of the sampling programme are then interpreted by Ministry of the Environment personnel. The results of the Self-Help Programme on Lake of Bays are summarized in the section entitled "Transparency and Chlorophyll a".

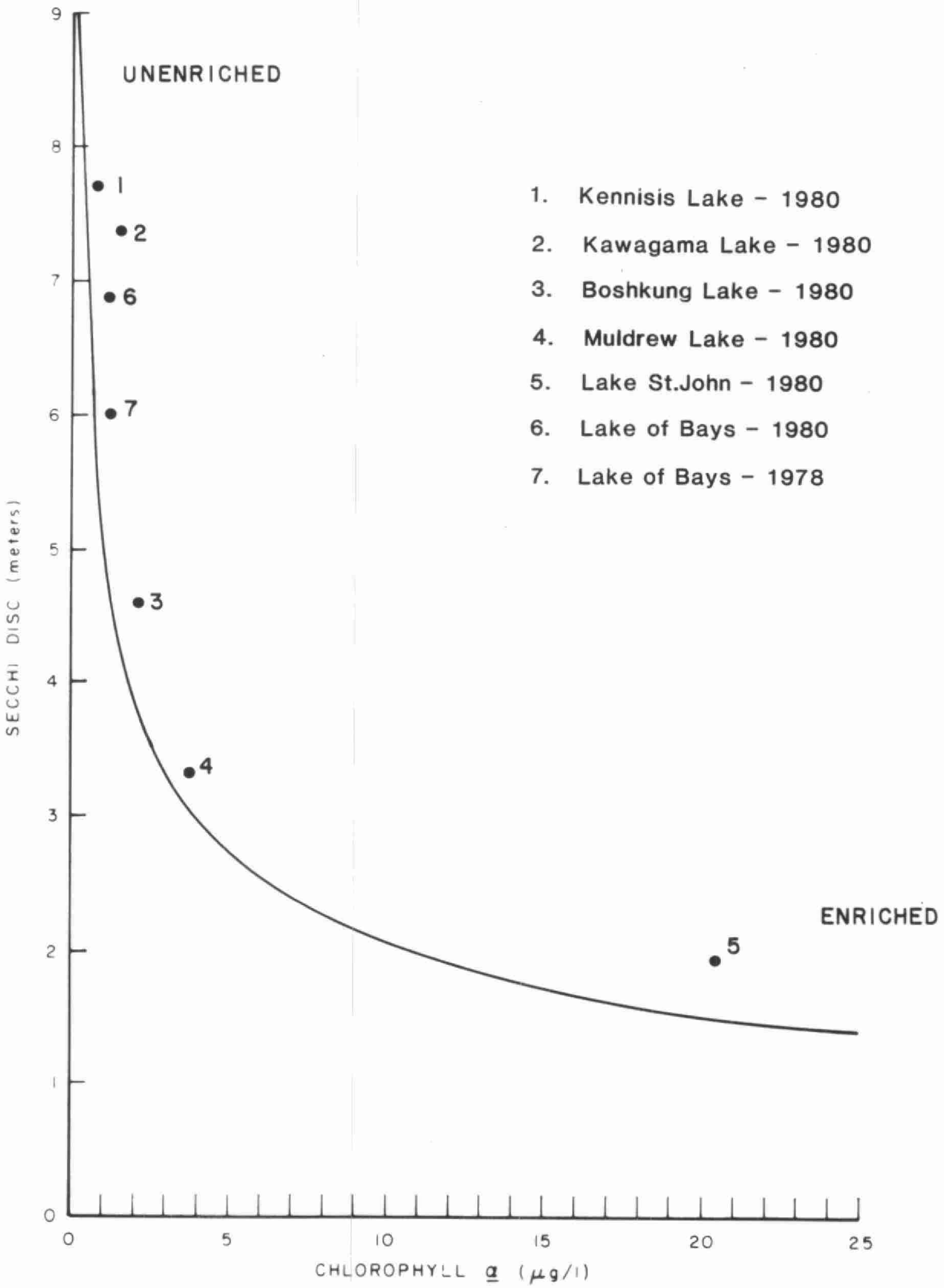

Figure 2 : Relationship between Secchi disc reading and chlorophyll *a* concentration (summer euphotic zone average) in southern Ontario lakes. Data were obtained from the 1980 Self Help Program and the 1978 water quality survey of Lake of Bays.

TEMPERATURE AND DISSOLVED OXYGEN

Lake of Bays is a typical temperate lake of moderate size which is dimictic, that is, it undergoes two periods of mixing: spring and fall.

In the spring, as water temperatures become uniform from the surface to the bottom, wind and wave action cause mixing and the lake overturns. In Lake of Bays in 1978, spring overturn occurred in early May. At this time, water temperature averaged 3°C and dissolved oyxgen concentration averaged 11 mg/L from the surface to the bottom of the lake at Station 1 (Figure 3a).

In the summer, the surface waters of Lake of Bays became warmer and less dense than the colder, bottom waters and, as a result, the lake became thermally stratified. This occurred in June, 1978 and by July 12, 1978, three distinct layers of different temperature and density were quite well-defined (Figure 3b): the epilimnion or surface layer, the metalimnion or middle layer and the hypolimnion or bottom layer.

Within the epilimnion, there was very little fluctuation of water temperature. The maximum temperature recorded was 23°C in the epilimnion during July and August. In the metalimnion however, there was a significant decrease in temperature. This rapid temperature decrease is referred to as the thermocline. There was very little fluctuation in water temperature in the hypolimnion. The minimum temperatures recorded were 4°C at the deepest stations and 5.5°C at the shallower stations. A minimum dissolved oxygen concentration of 6.0 mg/L was observed in the hypolimnion at a station located on Haystack Bay, which is semi-enclosed and did not circulate freely with the main body of the lake. On the main body of the lake, the minimum dissolved oxygen concentration was 8.9 mg/L, one metre above the bottom at Station 8.

During thermal stratification in Lake of Bays, the water temperature decreased with depth and oxygen concentrations reached a maximum in the hypolimnion. This increase in oxygen concentration with depth is known as an orthograde oxygen profile and is typical of clear, unenriched lakes (Figure 3b).

The optimal conditions for lake trout, based on a maximum temperature of 10 °C and a minimum dissolved oxygen concentration of 5 mg/L, were exceeded at every station. Lake trout habitat was limited only by the warming of the surface water (top ten metres) to temperatures greater than 10 °C. Since dissolved oxygen concentrations never decreased to less than 6.0 mg/L, this was not a limiting factor to the lake trout habitat. The temperature and dissolved oxygen profiles for the eight stations on Lake of Bays are shown in Figures 4-11 in the Appendix. The lake trout habitat is indicated as the area below the dotted line (10 °C) on the isotherm graphs.

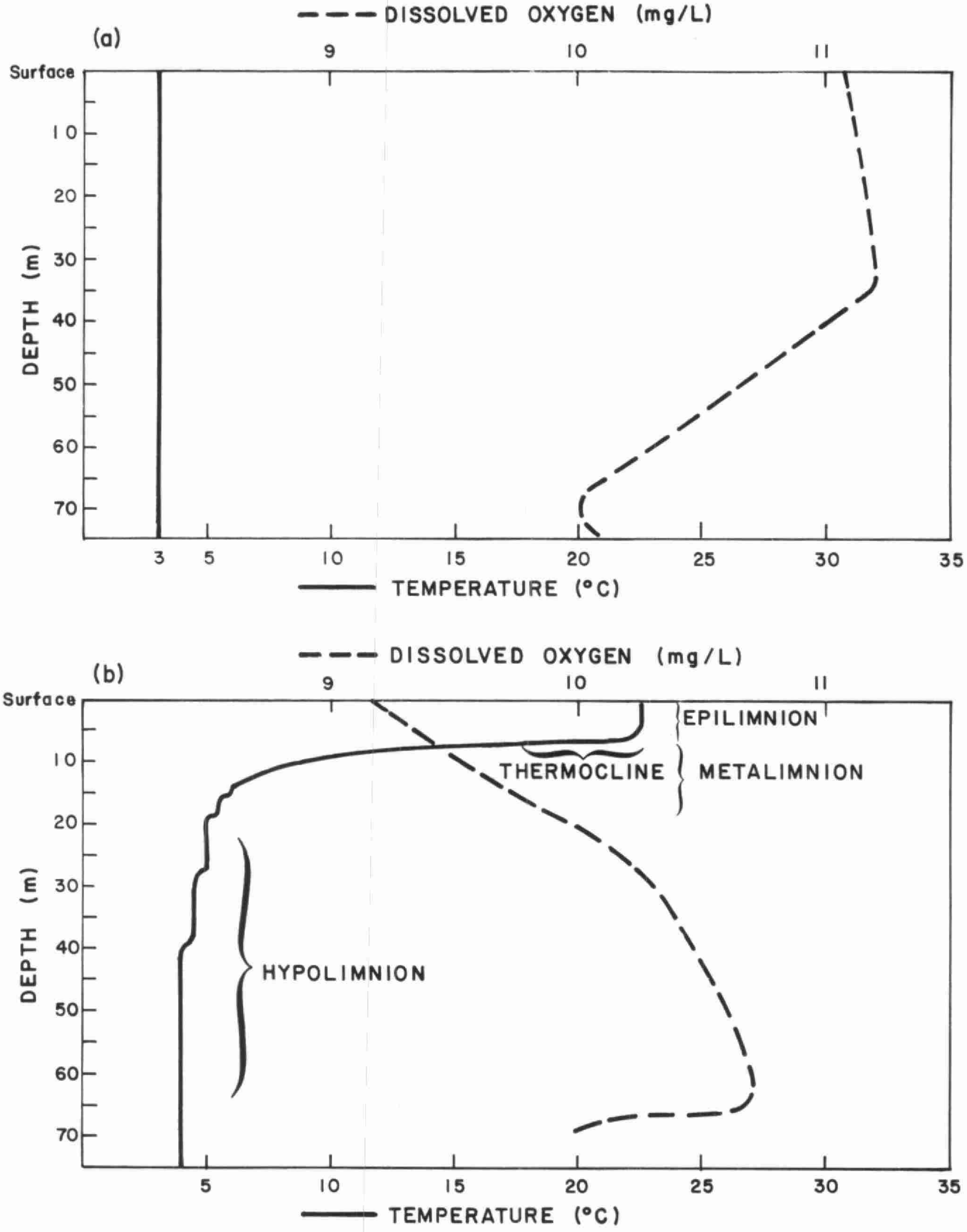

Figure 3 : Vertical distribution of oxygen concentrations and temperature during (a) the spring turnover May 10, 1978 and (b) the summer thermal stratification period, July 12, 1978 at Station 1.

WATER CHEMISTRY

The average values for fixed endpoint alkalinity, hardness and conductivity, determined by the 1978 survey, were 6.3 mg/L as $CaCO_3$, 13.1 mg/L as $CaCO_3$, and 39 umhos/cm³, respectively, both in the euphotic zone and in the bottom waters. These values indicate that Lake of Bays has very soft water, typical of lakes located on the Precambrian Shield. Fluctuations from average values were minimal from station to station.

An acid rain monitoring program was conducted on Lake of Bays in 1980 to monitor specific water quality parameters which would indicate the sensitivity of the lake to acidic inputs. The parameters monitored were pH, total inflection point alkalinity, calcium, conductivity and colour. The average results for three stations sampled on Lake of Bays in 1980 were:

pH	6.5
Total Inflection Point Alkalinity	64 ueq/L
Calcium	3.9 mg/L
Conductivity	40.7 umhos/cm³
Colour	16 Hazen units

Of these parameters, total inflection point alkalinity is an extremely accurate indicator of the buffering capacity or ability of the lake to neutralize acidic inputs. It is a much more sensitive measurement than the fixed endpoint measurements taken in the 1978 survey mentioned previously.

In the Acid Sensitivity Survey Ontario,(6) the following guideline was given for lake sensitivity to acidic inputs:

Lake Designation	Total Inflection Point Alkalinity	Sensitivity
Level 1	less than 0 ueq/L	acidified
Level 2	0 - 39.9 ueq/L	extreme sensitivity
Level 3	40-199 ueq/L	moderate sensitivity
Level 4	200-499 ueq/L	low sensitivity
Level 5	greater than 500 ueq/L	non-sensitive

According to this guideline, Lake of Bays would be considered moderately sensitive. This level of sensitivity is typical of lakes located on the Precambrian Shield.

The major ions measured (Cl^-, Na^+, K^+, Ca^{++}, SO_4^{++}, and Mg^{++}), showed no major fluctuations in concentration from the euphotic zone to the bottom waters and were within the range normally encountered in Precambrian Shield lakes.

Analyses were also done for total carbon (TC), total organic carbon (TOC), and total inorganic carbon (TIC). Total organic carbon is the most important of these parameters and measures the amount of partially degraded plant and animal material and humic substances present both in the dissolved and particulate form. The range for TOC in natural waters varies from 1 to 30 mg/L(2). Excessive amounts of TOC can lower the amount of dissolved oxygen in the water due to the high oxygen demand for bacterial respiration in decomposition of this organic matter. It has been observed that levels of less than 3.0 mg/L are acceptable(2). In Lake of Bays, TOC levels averaged 2.9 mg/L both in the euphotic zone and in the bottom waters. Total inorganic carbon (TIC) is the amount of carbonic acid, carbonates and bicarbonates present in the lake. Excessive levels of TIC cause scale to form in water pipes and electric kettles. In Lake of Bays, levels of TIC were quite low and averaged 0.9 mg/L in the euphotic zone and were only slightly higher in the bottom waters.

NUTRIENTS

The natural aquatic plant and algae growth in a lake is influenced mainly by the morphometry of the water body and the supply of nutrients, especially phosphorus.

A general guideline for phosphorus concentrations in waterbodies is provided in the publication, "Water Management - Goals, Policies, Objectives and Implementation Procedures of the Ministry of the Environment"(4). This guideline states that "a high level of protection again aesthetic deterioration will be provided by a total phosphorus concentration for the ice-free period of 10 ug/L or less. This should apply to all lakes naturally below this value".

In Lake of Bays, the average concentration of total phosphorus was 7.0 ug/L, both in the euphotic zone, and in the bottom waters. This concentration of phosphorus is low. There was no increase in phosphorus concentration in the bottom waters, as there was sufficient oxygen in the bottom waters to support the bacterial decomposition of organic detritus which settled to the bottom of the lake.

Four different forms of nitrogen were measured in this survey: total Kjeldahl (TKN), free ammonia, nitrite and nitrate nitrogen. Total Kjeldahl nitrogen is a measure of free ammonia and organic nitrogen present in the water, but does not include nitrate and nitrite nitrogen.

The normal range for TKN in natural waters is 0.1 to 0.5 mg/L(2). In Lake of Bays, the concentration was low, averaging 0.21 mg/L in the euphotic zone and 0.71 mg/L in the bottom waters. There was no evidence of accumulation in the bottom waters.

Free ammonia (NH_3) is an inorganic form of nitrogen produced by the decomposition of organic matter. The distribution of free ammonia in lakes is highly variable. Concentrations are normally low in lakes that are well-oxygenated and unenriched. In Lake of Bays, free ammonia concentrations were low averaging 0.013 mg/L, both in the euphotic zone and in the bottom waters and there was no discernible increase in concentration with depth.

Nitrite (NO_2) is a form of inorganic nitrogen that is unstable in the presence of oxygen. In natural waters, nitrite concentrations are usually less than 0.01 mg/L(2). In Lake of Bays, nitrite concentrations were low, averaging .002 mg/L both in the euphotic zone in the bottom waters.

Nitrate (NO_3) is the principal form of combined, inorganic nitrogen present in lakes and is a necessary requirement for photosynthesis in aquatic plants and algae. In natural waters, nitrate concentrations are usually less than 1 mg/L(2). In Lake of Bays, nitrate concentrations averaged 0.26 mg/L both in the euphotic zone and in the bottom waters.

TRANSPARENCY AND CHLOROPHYLL A

Water transparency was measured by lowering a Secchi disc* into the water and measuring the depth at which the disc disappears from sight. The depth of light penetration, or euphotic zone, is determined by doubling the Secchi disc reading. Almost all photosynthesis by aquatic plants and algae occurs within the euphotic zone. Chlorophyll a samples were taken as composites of water from the top to the bottom of the euphotic zone.

During the 1978 water quality survey of Lake of Bays, the average Secchi disc reading was 6.0 metres and the average chlorophyll a concentration was 1.4 ug/L.

The results of the Self-Help Programme, which has been conducted on Lake of Bays since 1977, indicate that the water quality of Lake of Bays has not changed significantly in the last four years. These results, averaged for all stations sampled on Lake of Bays, are summarized below:

Year	Secchi Disc Reading (m)	Total Chlorophyll a Concentration (ug/L)
1977	6.8	--
1978	7.0	1.3
1979	6.2	1.6
1980	6.8	1.4

The high Secchi disc readings and low chlorophyll a concentrations indicate that Lake of Bays is an unenriched lake with low nutrient levels. There is a definite relationship between Secchi disc readings and chlorophyll a concentrations which can be used to determine the enrichment status of a lake (Figure 2). The water quality of Lake of Bays compares favourably with Kawagama Lake and Kennisis Lake, which are two of Ontario's most desirable recreational lakes. Boshkung Lake and Muldrew Lake were moderately enriched, with a lower degree of water transparency and higher densities of suspended algae. Lake St. John was enriched with nutrients and experienced frequent algae blooms during the summer, as a result, water transparency was very low.

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* A round disc, 20 cm. in diameter, divided into black and white quadrants.

PHYTOPLANKTON

There was some variation in phytoplankton composition from station to station in Lake of Bays, however, the dominant classes of algae present were diatoms (Bacillariophyceae), averaging 31 per cent of the total biomass and yellow-brown algae (Chrysophyceae), averaging 25 per cent of the total biomass (Table 18). The average total phytoplankton biomass in Lake of Bays was .306 mm³/L. This level of phytoplankton biomass is typical of an unenriched or ultra-oligatrophic lake(7).

The major diatoms present were *Rhizosolenia*, *Stephanodiscus*, *Tabellaria*, *Asterionella*, *Fragilaria* and *Synedra*. The most commonly occurring yellow-brown algae were *Chrysosphaerella*, unidentified chrysomonads, *Dinobryon* and *Mallomonas*. The blue-green algae comprised 11 per cent of the total biomass. The main genera present were *Merismopedia*, *Coelosphaerium*, *Chroococcus*, and *Gomphosphaeria*. The dinoflagellates averaged 11 per cent of the total biomass but those measured for biomass were not identified to the genus level. The green algae averaged 10 per cent of the total biomass and the main genera present were *Gloeocystis*, *Oocystis*, *Crucigenia* and *Botryococcus*. The Cryptophyceae averaged 13 per cent of the total biomass. and *Cryptomonas* was the major genus present. This genus has been found to occupy a broad ecological niche, commonly occurring in enriched water, as well as in unenriched water.

The seasonal average total biomass and percentage composition of phytoplankton communities at the eight stations sampled on Lake of Bays is summarized in Figure 12. In general, the composition of the phytoplankton community in Lake of Bays is typical of an unenriched lake. Because the samples were recombined into one sample representing a seasonal average, it is difficult to relate phytoplankton community composition to a specific enrichment status. In order to do this, detailed information relating to seasonal succession, and species composition of the phytoplankton community would be required.

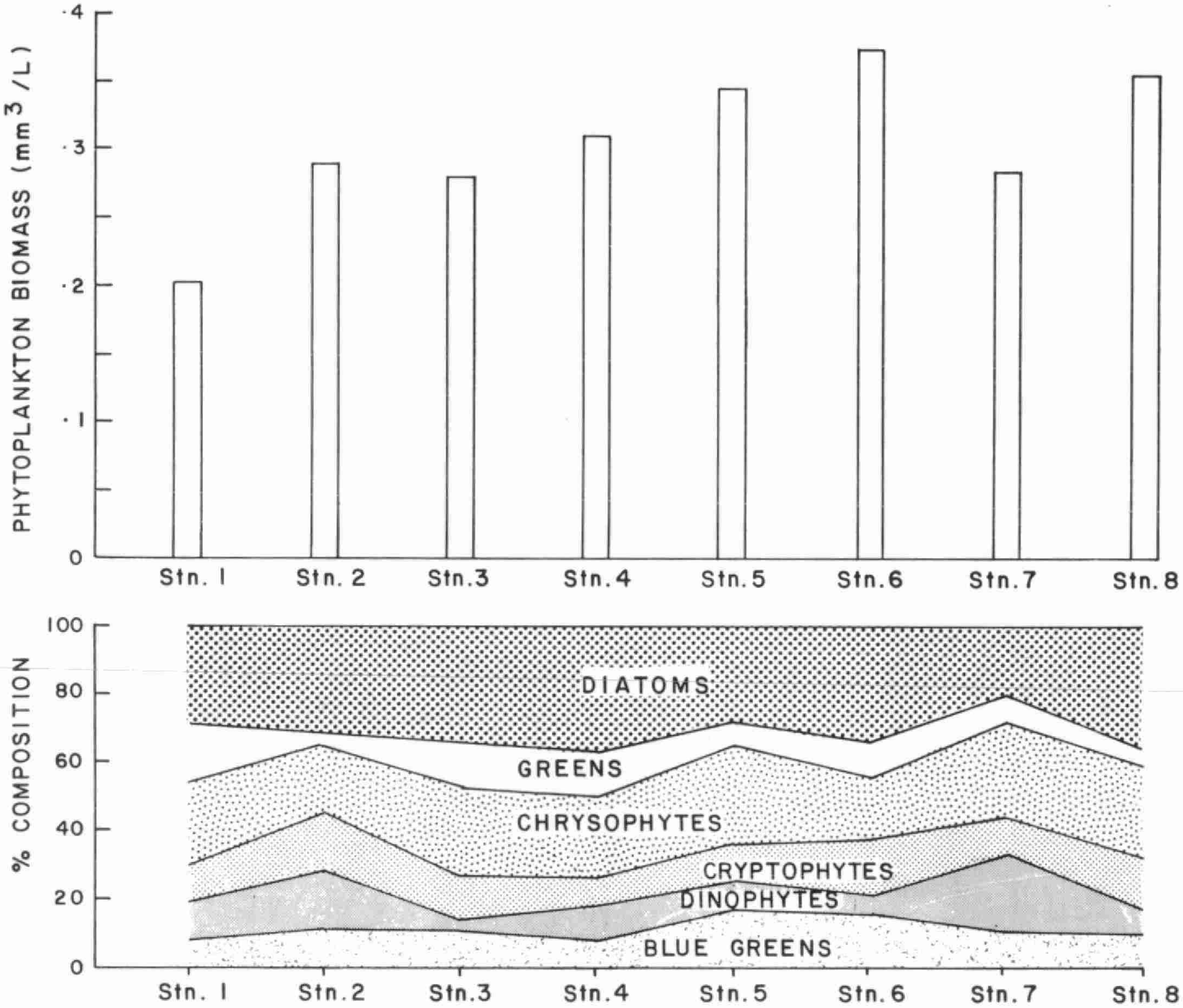

Figure 12: Total Phytoplankton Biomass and percentage composition at 8 Stations in Lake of Bays 1978.

SUMMARY

Lake of Bays is a large lake, with an extensive watershed and a complex shoreline, composed of numerous bays and inlets. It is dimictic, with two periods of mixing: spring and fall, and a period of thermal stratification in the summer. Lake of Bays is a soft-water lake, which is moderately sensitive to acidic precipitation due primarily to its location on the Precambrian Shield. It is well oxygenated and provides excellent habitat for lake trout, smallmouth bass and lake whitefish. Nutrient concentrations and phytoplankton concentrations at the time of sampling were low, characteristic of an unenriched lake.

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APPENDIX

TABLE 1: ANALYSES RESULTS LAKE OF BAYS 1978 STATION: 1

Date	Sample Depth (m)	Secchi Disc Reading (m)	Chlorophyll a (ug/L)	Total Phosphorus (ug/L)	NITROGEN				Conductivity (umhos/cm³)	
					TKN (mg/L)	NH_3 (mg/L)	NO_2 (mg/L)	NO_3 (mg/L)		
May 10	0-11	5.5	0.7	6	.15	.008	.001	.245	E	Euphotic Zone
May 29	0-12	6.0	1.5	7	.18	.004	.003	.215	38.0	
June 19	0-13	6.5	1.1	5	.17	.008	.002	.220	37.5	
July 12	0-12	6.0	1.4	10	.21	.018	.002	.178	38.5	
August 1	0-11	5.5	1.3	3	.26	.012	.003	.167	40.0	
August 25	0-13	6.5	2.0	5	.22	.010	.003	.145	37.5	
September 19	0-13	6.5	1.6	6	.22	.016	.003	.175	-	
May 10	73			5	.15	.012	.001	.245	E	Bottom Waters
May 29	68			6	.17	.002	.002	.245	E	
June 19	66			5	.15	.008	.002	.255	E	
July 12	68			7	.16	.014	.001	.250	38	
August 1	68			3	.13	.010	.002	.258	38	
August 25	68			6	.15	.004	.002	.275	37	
September 19	72			7	.15	.006	.002	.290	37	

E - Sample exhausted

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TABLE 2: ANALYSES RESULTS LAKE OF BAYS 1978 STATION: 1

Date	Sample Depth (m)	Alkalinity (TFE) (mg/L as CaCO$_3$)	Hardness (mg/L as CaCO$_3$)	Conductivity (umhos/cm^3)	Chloride (mg/L)	Sodium (mg/L)	Potassium (mg/L)	Calcium (mg/L)	Sulphate (mg/L)	Magnesium (mg/L)	Total Carbon (mg/L)	Total Organic Carbon (mg/L)	Total Inorganic Carbon (mg/L)	
May 10	0-11	5.0	13	38.5	1.3	1.4	0.5	3.4	9.0	1.0	3.5	2.5	1.0	Euphotic Zone
Sept. 19	0-13	6.2	13	37.5	1.4	1.4	0.45	3.8	9.5	0.95	3.8	2.8	1.0	
May 10	73	6.0	13	40.0	1.3	1.4	0.5	3.6	8.5	1.0	3.5	2.5	1.0	Bottom Waters
Sept. 19	72	5.8	13	37.5	1.2	1.5	0.5	3.8	9.0	0.95	3.6	2.2	1.4	

TABLE 3: ANALYSES RESULTS LAKE OF BAYS 1978 STATION: 2

					NITROGEN					
Date	Sample Depth (m)	Secchi Disc Reading (m)	Chlorophyll a (ug/L)	Total Phosphorus (ug/L)	TKN (mg/L)	NH_3 (mg/L)	NO_2 (mg/L)	NO_3 (mg/L)	Conductivity (umhos/cm³)	
May 11	0-16	8.0	0.9	7	0.21	0.004	0.001	0.230	E	Euphotic Zone
May 29	0-14	7.0	1.5	8	0.21	0.006	0.003	0.205	37.5	
June 19	0-13	6.5	1.0	6	0.22	0.010	0.002	0.210	38.0	
July 11	0-12	6.0	1.6	8	0.25	0.016	0.002	0.178	39.0	
August 2	0-14	7.0	1.5	5	0.19	0.014	0.003	0.167	38.0	
August 25	0-13	6.5	2.2	5	0.24	0.012	0.003	0.140	37.0	
September 18	0-11	5.5	1.8	5	0.24	0.012	0.003	0.155	38.0	
May 11	39			6	0.13	0.002	0.001	0.225	E	Bottom Waters
May 29	52			6	0.19	0.004	0.002	0.240	E	
June 19	40			5	0.15	0.008	0.002	0.250	37.5	
July 11	41			7	0.16	0.022	0.001	0.240	38.0	
August 2	33			3	0.15	0.014	0.002	0.248	37.5	
August 25	44			5	0.22	0.012	0.002	0.265	37.0	
September 18	38			4	0.21	0.008	0.002	0.280	37.0	

E - Sample exhausted

JB/ns/REPT7-H-3

TABLE 4: ANALYSES RESULTS LAKE OF BAYS 1978 STATION: 2

Date	Sample Depth (m)	Alkalinity (TFE) (mg/L as $CaCO_3$)	Hardness (mg/L as $CaCO_3$)	Conductivity (umhos/cm^3)	Chloride (mg/L)	Sodium (mg/L)	Potassium (mg/L)	Calcium (mg/L)	Sulphate (mg/L)	Magnesium (mg/L)	Total Carbon (mg/L)	Total Organic Carbon (mg/L)	Total Inorganic Carbon (mg/L)	
May 11	0-16	6.0	13	39.0	1.3	1.4	0.50	3.6	9.0	1.0	3.4	2.4	1.0	Euphotic Zone
Sept. 18	0-11	6.4	13	38.5	1.4	1.3	0.50	3.8	9.0	0.9	3.8	3.0	0.8	
May 11	40	7.0	12	40	1.3	1.4	0.50	3.4	9.0	0.95	3.8	2.8	1.0	Bottom Waters
Sept. 18	39	6.2	13	38	1.2	1.5	0.50	3.6	9.0	0.95	3.6	2.6	1.0	

TABLE 5: ANALYSES RESULTS LAKE OF BAYS 1978 STATION: 3

Date	Sample Depth (m)	Secchi Disc Reading (m)	Chlorophyll a (ug/L)	Total Phosphorus (ug/L)	NITROGEN				Conductivity (umhos/cm³)	
					TKN (mg/L)	NH_3 (mg/L)	NO_2 (mg/L)	NO_3 (mg/L)		
May 11	0-12	6.0	0.7	7	0.12	0.004	0.002	0.235	E	Euphotic Zone
May 30	0-14	7.0	1.8	9	0.22	0.004	0.004	0.190	38.5	
June 19	0-12	6.0	1.8	5	0.15	0.010	0.002	0.195	37.5	
July 12	0-14	7.0	1.2	7	0.21	0.010	0.002	0.163	37.5	
August 2	0-13	6.5	1.4	4	0.28	0.016	0.003	0.157	37.5	
August 25	0-11	5.5	1.9	5	0.25	0.012	0.002	0.140	37.5	
September 18	0-11	5.5	1.8	5	0.40	0.012	0.003	0.145	37.5	
May 11	40			8	0.13	0.002	0.001	0.235	E	Bottom Waters
May 30	33			9	0.21	0.008	0.002	0.225	37.5	
June 19	36			7	0.14	0.014	0.002	0.240	37.5	
July 12	36			9	0.18	0.046	0.002	0.238	38.5	
August 2	36			6	0.17	0.022	0.002	0.248	38.0	
August 25	33			8	0.21	0.010	0.002	0.255	38.0	
September 18	30			7	0.30	0.008	0.002	0.280	38.0	

E - Sample exhausted

JB/ns/REPT7-H-4

TABLE 6: ANALYSES RESULTS LAKE OF BAYS 1978 STATION: 3

Date	Sample Depth (m)	Alkalinity (TFE) (mg/L as $CaCO_3$)	Hardness (mg/L as $CaCO_3$)	Conductivity (umhos/cm^3)	Chloride (mg/L)	Sodium (mg/L)	Potassium (mg/L)	Calcium (mg/L)	Sulphate (mg/L)	Magnesium (mg/L)	Total Carbon (mg/L)	Total Organic Carbon (mg/L)	Total Inorganic Carbon (mg/L)	
May 11	0-12	7.0	14	42.5	1.4	1.6	0.55	3.8	9.0	1.00	3.6	2.6	1.0	Euphotic Zone
Sept. 18	0-11	6.6	13	38.0	1.4	1.5	0.50	3.6	9.0	0.95	3.7	2.9	0.8	
May 11	40	6.0	16	40	1.4	1.5	0.50	4.6	9.0	1.0	3.4	2.4	1.0	Bottom Waters
Sept. 18	30	6.8	14	39	1.4	1.5	0.50	4.0	9.0	1.0	4.4	2.6	1.8	

TABLE 7: ANALYSES RESULTS LAKE OF BAYS 1978 STATION: 4

Date	Sample Depth (m)	Secchi Disc Reading (m)	Chlorophyll a (ug/L)	Total Phosphorus (ug/L)	NITROGEN				Conductivity (umhos/cm³)	
					TKN (mg/L)	NH_3 (mg/L)	NO_2 (mg/L)	NO_3 (mg/L)		
May 11	0-12	6.0	1.2	6	0.14	0.006	0.001	0.210	E	Euphotic Zone
May 30	0-12	6.0	1.9	7	0.18	0.004	0.003	0.175	36.0	
June 19	0.14	7.0	1.2	6	0.16	0.008	0.002	0.175	36.5	
July 11	0-14	7.0	1.1	7	0.21	0.026	0.002	0.153	38.0	
August 2	0-14	7.0	1.5	3	0.16	0.010	0.002	0.138	37.0	
August 25	0-13	6.5	2.1	5	0.23	0.014	0.003	0.150	36.5	
September 18	0-11	5.5	1.6	5	0.49	0.014	0.003	0.125	34.5	
May 11	42			6	0.13	0.006	0.001	0.210	E	Bottom Waters
May 30	40			5	0.17	0.004	0.002	0.215	37.5	
June 19	42			6	0.14	0.012	0.002	0.225	37.5	
July 11	44			7	0.17	0.030	0.001	0.220	38.5	
August 2	41			6	0.15	0.016	0.002	0.223	38.0	
August 25	42			7	0.16	0.010	0.002	0.245	37.5	
September 18	39			8	0.18	0.010	0.002	0.260	38.5	

E - Sample exhausted

JB/ns/REPT7-H-5

TABLE 8: ANALYSES RESULTS LAKE OF BAYS 1978 STATION: 4

Date	Sample Depth (m)	Alkalinity (TFE) (mg/L as $CaCO_3$)	Hardness (mg/L as $CaCO_3$)	Conductivity (umhos/cm^3)	Chloride (mg/L)	Sodium (mg/L)	Potassium (mg/L)	Calcium (mg/L)	Sulphate (mg/L)	Magnesium (mg/L)	Total Carbon (mg/L)	Total Organic Carbon (mg/L)	Total Inorganic Carbon (mg/L)	
May 11	0-12	5.0	12	39.0	1.4	1.4	0.55	3.4	9.0	0.95	3.4	2.4	1.0	Euphotic Zone
Sept. 18	0-11	6.4	13	36.5	1.1	1.4	0.50	3.8	9.0	0.90	4.2	3.4	0.8	
May 11	42	5.0	12	39.0	1.4	1.4	0.50	3.4	9.0	0.95	3.3	2.3	1.0	Bottom Waters
Sept. 18	39	6.7	14	39.5	1.5	1.6	0.50	4.0	9.0	0.95	5.0	3.2	1.8	

JB/ns/REPT7-I-6

TABLE 9: ANALYSES RESULTS LAKE OF BAYS 1978 STATION: 5

Date	Sample Depth (m)	Secchi Disc Reading (m)	Chlorophyll a (ug/L)	Total Phosphorus (ug/L)	NITROGEN				Conductivity (umhos/cm³)	
					TKN (mg/L)	NH_3 (mg/L)	NO_2 (mg/L)	NO_3 (mg/L)		
May 12	0-12	6.0	0.9	7	0.14	0.068	0.005	0.410	37.9	Euphotic Zone
May 29	0-16	8.0	1.3	7	0.21	0.002	0.003	0.200	E	
June 20	0-14	7.0	1.3	6	0.19	0.008	0.002	0.200	38.0	
July 11	0-12	6.0	1.3	16	0.23	0.016	0.002	0.168	38.5	
August 2	0-12	6.0	1.7	4	0.16	0.008	0.002	0.158	37.5	
August 29	0-10	5.0	1.9	6	0.23	0.010	0.003	0.120	37.5	
September 20	0-11	5.5	1.9	5	0.20	0.012	0.003	0.140	37.5	
May 12	35			7	0.14	0.048	0.004	0.280	37.8	Bottom Waters
May 29	39			7	0.18	0.002	0.002	0.225	38.0	
June 20	38			6	0.17	0.014	0.002	0.240	37.5	
July 11	37			14	0.20	0.018	0.001	0.230	38.5	
August 2	38			5	0.13	0.016	0.002	0.248	38.0	
August 29	38			9	0.17	0.006	0.002	0.270	37.5	
September 20	38			8	0.16	0.014	0.002	0.270	38.5	

E - Sample exhausted

JB/ns/REPT7-H-6

TABLE 10: ANALYSES RESULTS LAKE OF BAYS 1978 STATION: 5

Date	Sample Depth (m)	Alkalinity (TFE) (mg/L as $CaCO_3$)	Hardness (mg/L as $CaCO_3$)	Conductivity (umhos/cm^3)	Chloride (mg/L)	Sodium (mg/L)	Potassium (mg/L)	Calcium (mg/L)	Sulphate (mg/L)	Magnesium (mg/L)	Total Carbon (mg/L)	Total Organic Carbon (mg/L)	Total Inorganic Carbon (mg/L)	
May 12	0-12	8.0	13	38.5	1.3	1.4	0.55	3.6	9.0	1.0	3.3	2.3	1.0	Euphotic Zone
Sept. 20	0-11	6.4	12	38.0	1.4	1.3	0.50	3.4	9.0	0.95	3.7	2.9	0.8	
May 12	35	7.0	14	41.0	1.3	1.5	0.55	3.8	9.5	1.0	3.6	2.2	1.4	Bottom Waters
Sept. 20	38	7.0	13	39.5	1.4	1.3	0.55	3.4	9.0	1.0	4.3	2.3	2.0	

JB/ns/REPT7-I-5

TABLE 11: ANALYSES RESULTS LAKE OF BAYS 1978 STATION: 6

Date	Sample Depth (m)	Secchi Disc Reading (m)	Chlorophyll a (ug/L)	Total Phosphorus (ug/L)	NITROGEN TKN (mg/L)	NH_3 (mg/L)	NO_2 (mg/L)	NO_3 (mg/L)	Conductivity (umhos/cm³)	
May 9	0-10	5.0	0.5	6	0.18	0.022	0.002	0.270	E	Euphotic Zone
May 30	0-8.5	4.25	1.9	8	0.23	0.002	0.003	0.210	36.5	
June 20	0-12	6.0	1.1	9	0.24	0.010	0.002	0.210	37.0	
July 13	0-11	5.5	1.3	7	0.21	0.040	0.002	0.173	39.5	
August 3	0-13	6.5	1.3	9	0.17	0.016	0.002	0.168	37.0	
August 28	0-10	5.0	2.0	10	0.23	0.018	0.003	0.120	38.0	
September 19	0-10	5.0	1.5	10	0.19	0.016	0.003	0.135	38.0	
May 9	48			15	0.28	0.066	0.001	0.260	E	Bottom Waters
May 30	48			17	0.22	0.014	0.002	0.280	36.5	
June 20	49			8	0.20	0.018	0.002	0.285	36.5	
July 13	50			9	0.21	0.024	0.002	0.273	36.5	
August 3	50			7	0.16	0.006	0.002	0.293	37.0	
August 28	51			7	0.20	0.004	0.002	0.310	36.0	
September 19	49			7	0.17	0.006	0.002	0.325	36.5	

E - Sample exhausted

JB/ns/REPT7-H-7

TABLE 12: ANALYSES RESULTS LAKE OF BAYS 1978 STATION: 6

Date	Sample Depth (m)	Alkalinity (TFE) (mg/L as $CaCO_3$)	Hardness (mg/L as $CaCO_3$)	Conductivity (umhos/cm^3)	Chloride (mg/L)	Sodium (mg/L)	Potassium (mg/L)	Calcium (mg/L)	Sulphate (mg/L)	Magnesium (mg/L)	Total Carbon (mg/L)	Total Organic Carbon (mg/L)	Total Inorganic Carbon (mg/L)	
May 9	0-10	6.0	17	39.0	1.3	1.5	0.55	5.0	9.5	1.00	4.6	3.6	1.0	Euphotic Zone
Sept. 19	0-10	6.5	12	38.5	1.5	1.4	0.50	3.4	9.0	0.95	4.2	3.4	0.8	
May 9	49	9.0	13	43.5	1.3	1.4	0.50	3.6	9.0	1.0	5.4	3.6	1.8	Bottom Waters
Sept. 19	46	5.4	12	37.5	1.4	1.2	0.50	3.4	9.0	0.95	4.4	3.2	1.2	

TABLE 13: ANALYSES RESULTS LAKE OF BAYS 1978 STATION: 7

Date	Sample Depth (m)	Secchi Disc Reading (m)	Chlorophyll a (ug/L)	Total Phosphorus (ug/L)	NITROGEN TKN (mg/L)	NITROGEN NH_3 (mg/L)	NITROGEN NO_2 (mg/L)	NITROGEN NO_3 (mg/L)	Conductivity (umhos/cm³)	
May 8	0-10	5.0	0.8	8	0.19	0.006	0.002	0.245	E	Euphotic Zone
May 30	0- 9	4.5	2.2	9	0.22	0.004	0.003	0.210	37.5	
June 20	0-11	5.5	1.3	7	0.19	0.008	0.002	0.210	37.0	
July 13	0-11	5.5	1.6	7	0.21	0.034	0.002	0.173	38.5	
August 3	0-12	6.0	1.5	5	0.17	0.016	0.003	0.147	37.5	
August 28	0-10	5.0	1.9	11	0.29	0.020	0.003	0.120	37.0	
September 20	0-12	6.0	2.1	8	0.22	0.014	0.003	0.150	37.5	
May 8	40			8	0.17	0.006	0.002	0.240	38.5	Bottom Waters
May 30	43			7	0.17	0.004	0.002	0.240	38.0	
June 20	43			8	0.15	0.010	0.002	0.250	38.0	
July 13	44			9	0.19	0.056	0.002	0.258	41.5	
August 3	43			8	0.14	0.010	0.002	0.258	38.0	
August 28	46			6	0.16	0.008	0.002	0.260	38.0	
September 20	44			9	0.14	0.008	0.002	0.275	38.5	

E - Sample exhausted

JB/ns/REPT7-H-8

TABLE 14: ANALYSES RESULTS LAKE OF BAYS 1978 STATION: 7

Date	Sample Depth (m)	Alkalinity (TFE) (mg/L as $CaCO_3$)	Hardness (mg/L as $CaCO_3$)	Conductivity (umhos/cm^3)	Chloride (mg/L)	Sodium (mg/L)	Potassium (mg/L)	Calcium (mg/L)	Sulphate (mg/L)	Magnesium (mg/L)	Total Carbon (mg/L)	Total Organic Carbon (mg/L)	Total Inorganic Carbon (mg/L)	
May 8	0-10	6.0	13	39.5	1.3	1.4	0.50	3.6	9.0	1.0	3.7	2.7	1.0	Euphotic Zone
Sept. 20	0-12	6.5	14	38.5	1.4	1.6	0.50	4.0	9.0	0.95	3.6	2.8	0.8	
May 8	40	6.0	13	39.5	1.3	1.4	0.55	3.4	9.0	1.05	3.8	2.8	1.0	Bottom Waters
Sept. 20	44	6.6	14	39.0	1.4	1.5	0.45	4.0	9.0	1.00	4.6	2.6	2.0	

JB/ns/REPT7-I-3

TABLE 15: ANALYSES RESULTS LAKE OF BAYS 1978 STATION: 8

Date	Sample Depth (m)	Secchi Disc Reading (m)	Chlorophyll a (ug/L)	Total Phosphorus (ug/L)	NITROGEN				Conductivity (umhos/cm^3)	
					TKN (mg/L)	NH_3 (mg/L)	NO_2 (mg/L)	NO_3 (mg/L)		
May 10	0-11	5.5	0.5	6	0.18	0.008	0.002	0.245	E	Euphotic Zone
May 30	0-10	5.0	1.6	10	0.19	L0.002	0.003	0.225	37.0	
June 20	0-16	8.0	1.0	6	0.17	0.008	0.002	0.220	37.0	
July 12	0-13	6.5	1.4	7	0.20	0.014	0.002	9.178	37.5	
August 3	0-13	6.5	1.2	5	0.24	0.014	0.003	0.172	37.5	
August 29	0-11	5.5	1.8	5	0.22	0.016	0.003	0.110	32.0	
September 19	0-11	5.5	1.6	6	0.18	0.014	0.003	0.150	37.5	
May 10	46			5	0.16	0.008	0.001	0.245	E	Bottom Waters
May 30	43			7	0.20	0.004	0.002	0.245	E	
June 20	46			6	0.17	0.008	0.002	0.260	37.0	
July 12	44			7	0.16	0.050	0.002	0.268	38.5	
August 3	47			4	0.14	0.008	0.002	0.273	37.0	
August 29	47			7	0.18	0.004	0.002	0.280	36.5	
September 19	46			5	0.13	0.006	0.002	0.295	37.5	

E - Sample exhausted

L = less than

JB/ns/REPT7-H-9

TABLE 16: ANALYSES RESULTS LAKE OF BAYS 1978 STATION: 8

Date	Sample Depth (m)	Alkalinity (TFE) (mg/L as $CaCO_3$)	Hardness (mg/L as $CaCO_3$)	Conductivity (umhos/cm^3)	Chloride (mg/L)	Sodium (mg/L)	Potassium (mg/L)	Calcium (mg/L)	Sulphate (mg/L)	Magnesium (mg/L)	Total Carbon (mg/L)	Total Organic Carbon (mg/L)	Total Inorganic Carbon (mg/L)	
May 10	0-11	6.0	13	39.5	1.3	1.5	0.55	3.4	9.0	1.0	4.5	3.5	1.0	Euphotic Zone
Sept. 19	0-11	6.3	12	38.0	1.5	1.3	0.50	3.4	9.0	0.90	4.0	3.0	1.0	
May 10	46	6.0	13	39.0	1.3	1.5	0.45	3.4	9.0	1.00	4.0	3.0	1.0	Bottom Waters
Sept. 19	46	5.9	12	38.0	1.4	1.3	0.50	3.2	9.0	0.95	5.5	4.1	1.4	

TABLE 17: MEAN VALUES OF ANALYSES RESULTS LAKE OF BAYS 1978

Station	Sample Depth (m)	Secchi Disc Reading (m)	Chlorophyll *a* (ug/L)	Total Phosphorus (ug/L)	NITROGEN				Conductivity (umhos/cm³)	
					TKN (mg/L)	NH_3 (mg/L)	NO_2 (mg/L)	NO_3 (mg/L)		
1		6.1	1.4	6.0	.20	.011	.002	.192	38	Euphotic Zone
2		6.6	1.5	6.0	.22	.011	.002	.184	38	
3		6.2	1.3	6.0	.23	.010	.003	.175	38	
4		6.4	1.5	6.0	.22	.012	.002	.161	36	
5		6.2	1.5	7.3	.19	.018	.003	.199	38	
6		5.3	1.4	8.4	.21	.018	.002	.184	38	
7		5.4	1.6	7.9	.21	.015	.003	.179	38	
8		6.1	1.3	6.4	.20	.011	.003	.186	36	
1				6.0	.15	.008	.002	.260	38	Bottom Waters
2				5.0	.17	.010	.002	.250	37	
3				8.0	.19	.016	.002	.246	38	
4				6.0	.16	.013	.002	.228	38	
5				8.0	.16	.017	.002	.252	38	
6				10.0	.21	.020	.002	.289	37	
7				8.0	.16	.015	.002	.254	39	
8				5.9	.16	.013	.002	.267	37	

JB/ns/REPT7-K-2

TABLE 18: TOTAL PHYTOPLANKTON BIOMASS (mm^3/L) AND PERCENTAGE COMPOSITION OF PHYTOPLANKTON FROM 8 STATIONS IN LAKE OF BAYS IN 1978. ALL SAMPLES TAKEN FROM ONE STATION DURING THE SAMPLING PERIOD WERE RECOMBINED TO FORM ONE COMPOSITE SAMPLE WHICH SHOULD BE REPRESENTATIVE OF THE COMPOSITION FOR THE ENTIRE SAMPLING PERIOD.

		PERCENTAGE COMPOSITION(%)					
Lake Station	Total Phytoplankton Biomass (mm^3/L)	Diatoms (Bacillario-)	Yellow-Brown Algae (Chryso-)	Blue Green Algae (Cyano-)	Dino-Flagellates (Dino-)	Greens (Chloro-)	Cryptomonads (Crypto-)
1	.203	29	26	8	10	17	11
2	.290	32	20	11	17	3	17
3	.280	35	26	11	3	13	13
4	.311	37	24	7	11	13	8
5	.345	29	29	17	8	7	11
6	.374	33	19	16	5	11	16
7	.286	20	29	10	23	8	10
8	.355	35	28	10	8	5	14
Average	.306	31	25	11	11	10	13

JB/ns/REPT7-K-3

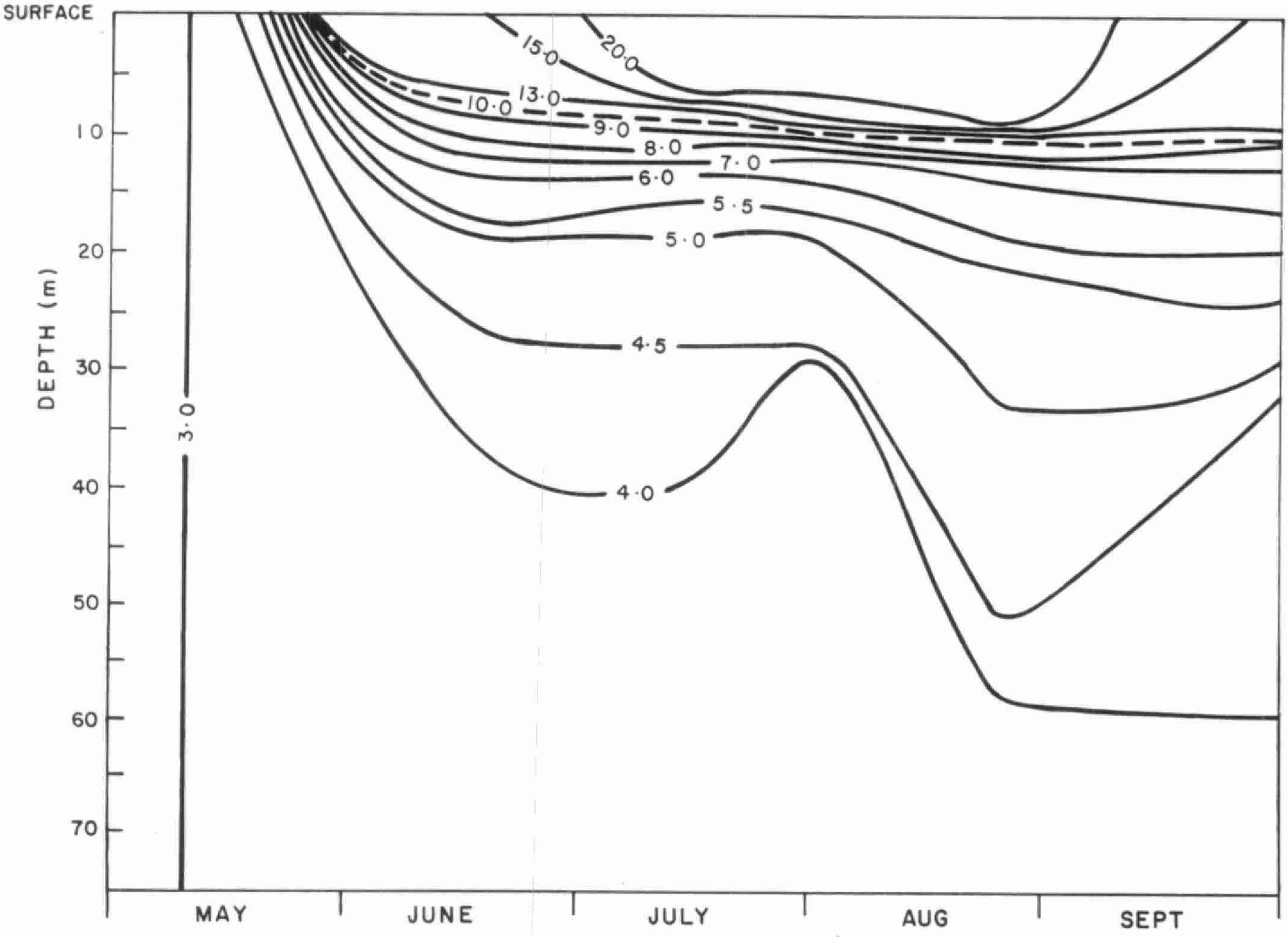

Figure 4a : Lake of Bays 1978 Station 1 – Isotherms (°C)

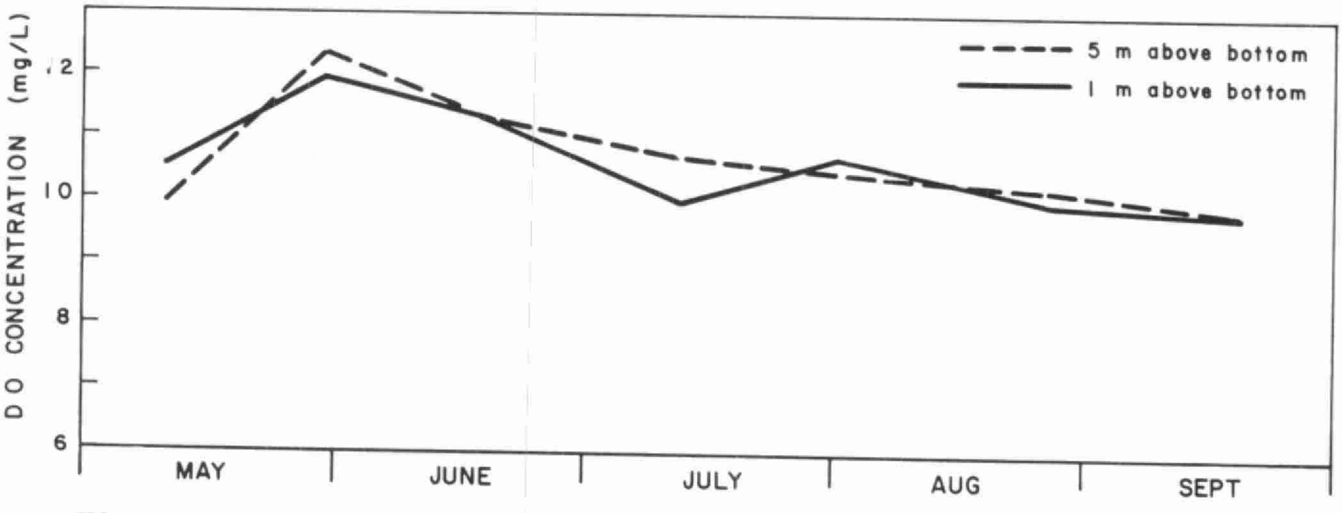

Figure 4b : Station 1 – Dissolved Oxygen Concentration (mg/L)

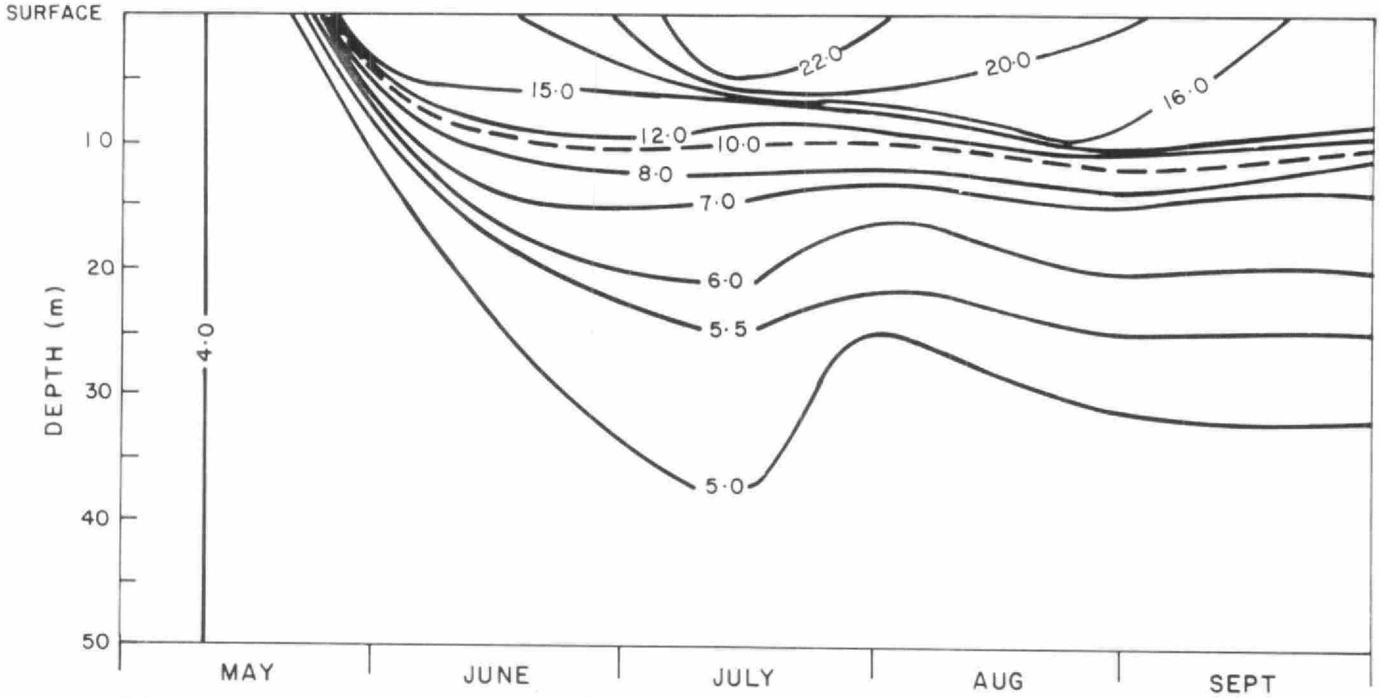

Figure 5a : Lake of Bays 1978 Station 2 – Isotherms (°C)

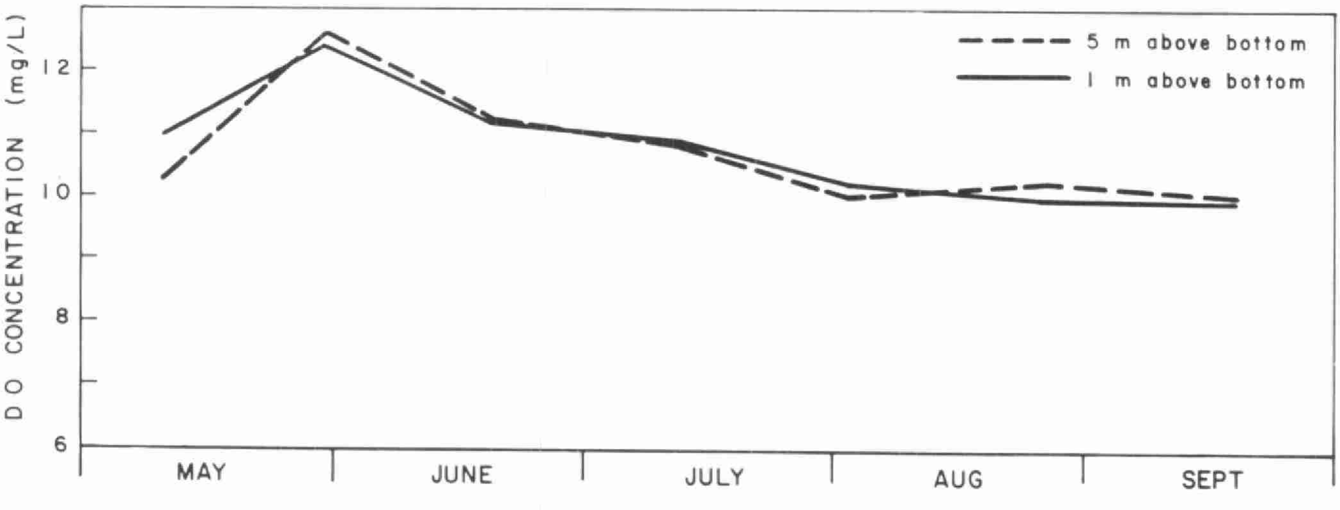

Figure 5b : Station 2 – Dissolved Oxygen Concentration (mg/L)

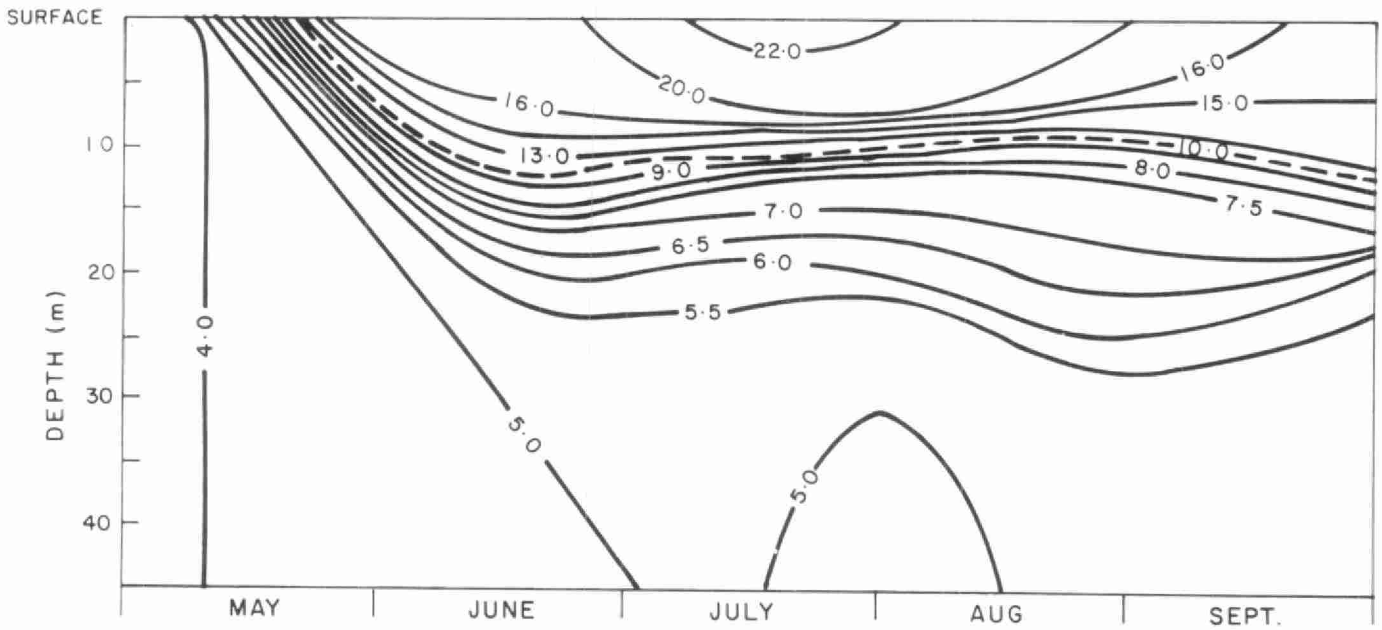

Figure 6a : Lake of Bays 1978 Station 3 — Isotherms (°C)

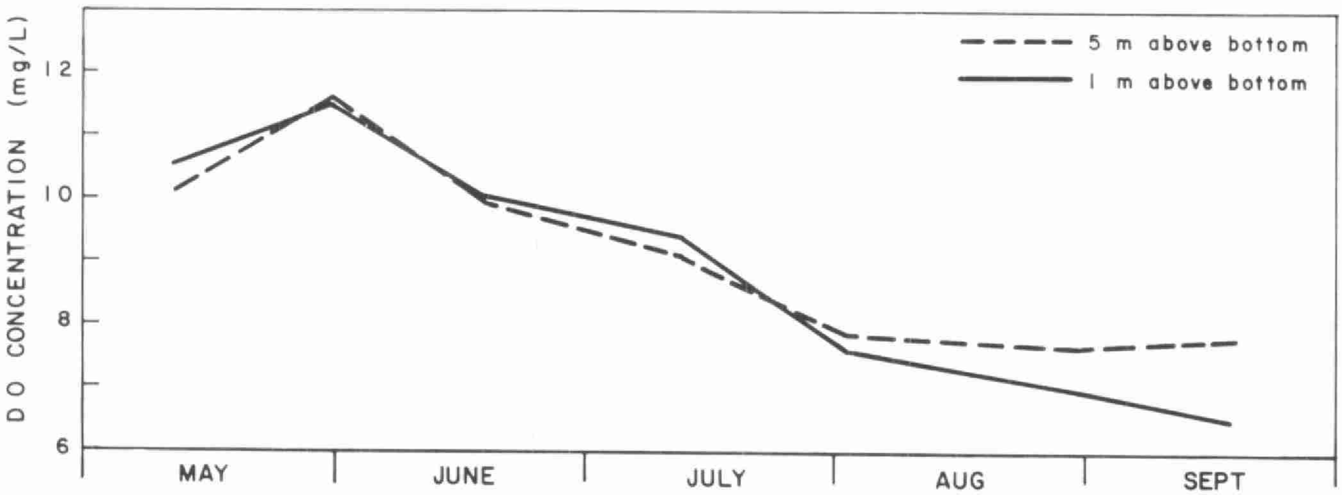

Figure 6b : Station 3 — Dissolved Oxygen Concentration (mg/L)

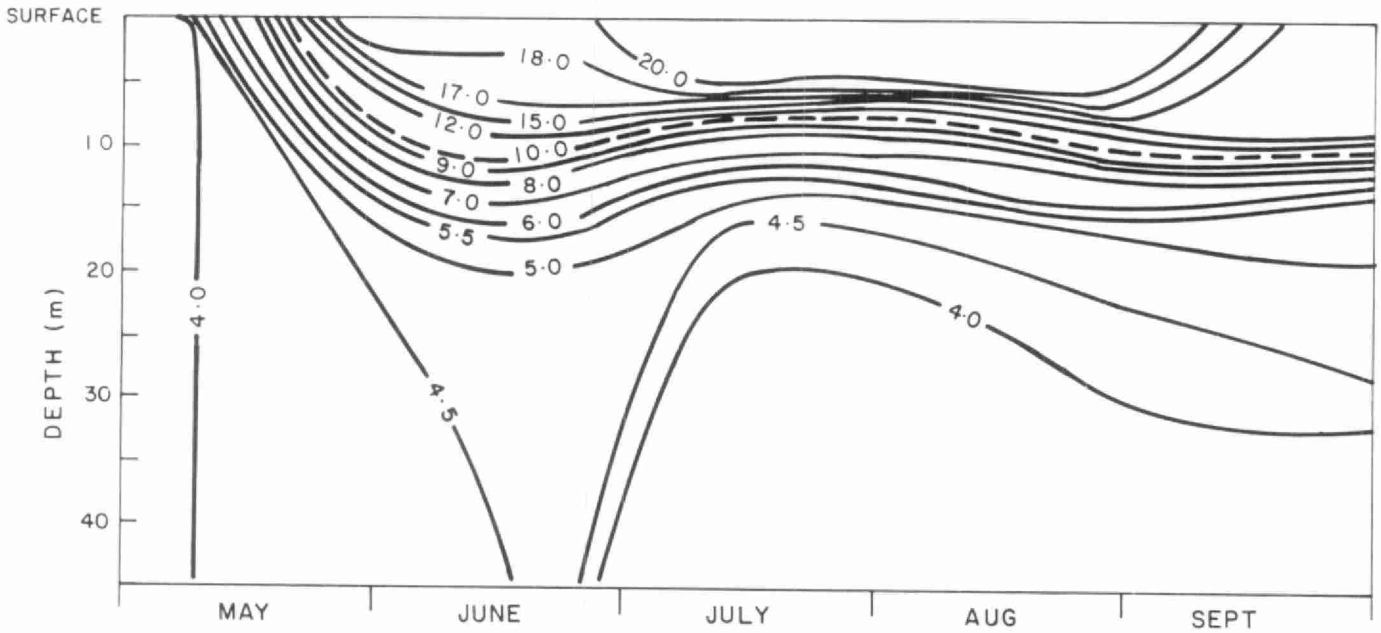

Figure 7a : Lake of Bays 1978 Station 4 – Isotherms (°C)

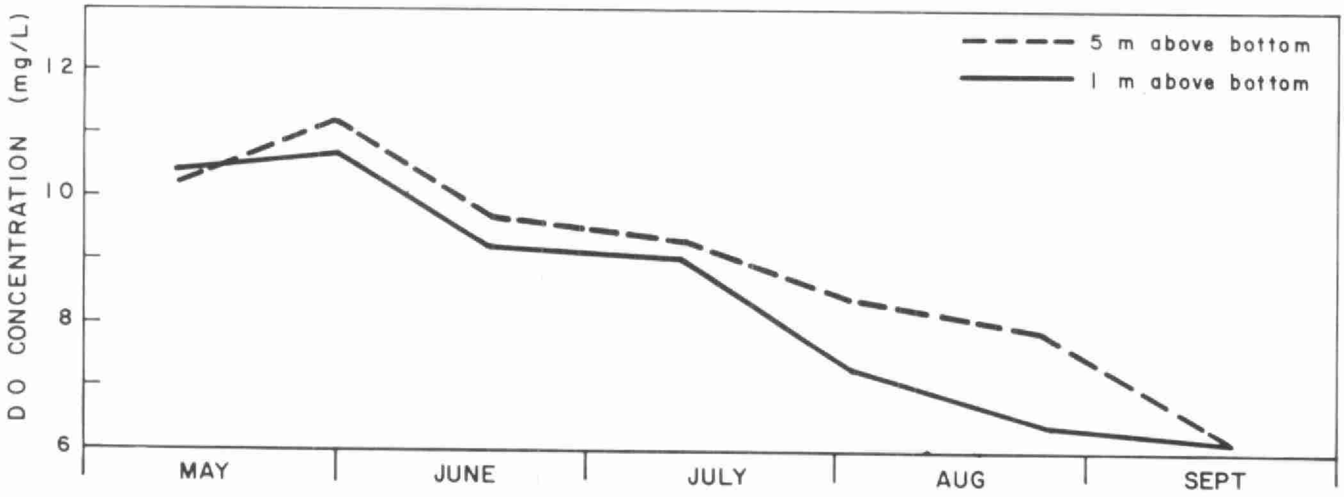

Figure 7b : Station 4 – Dissolved Oxygen Concentration (mg/L)

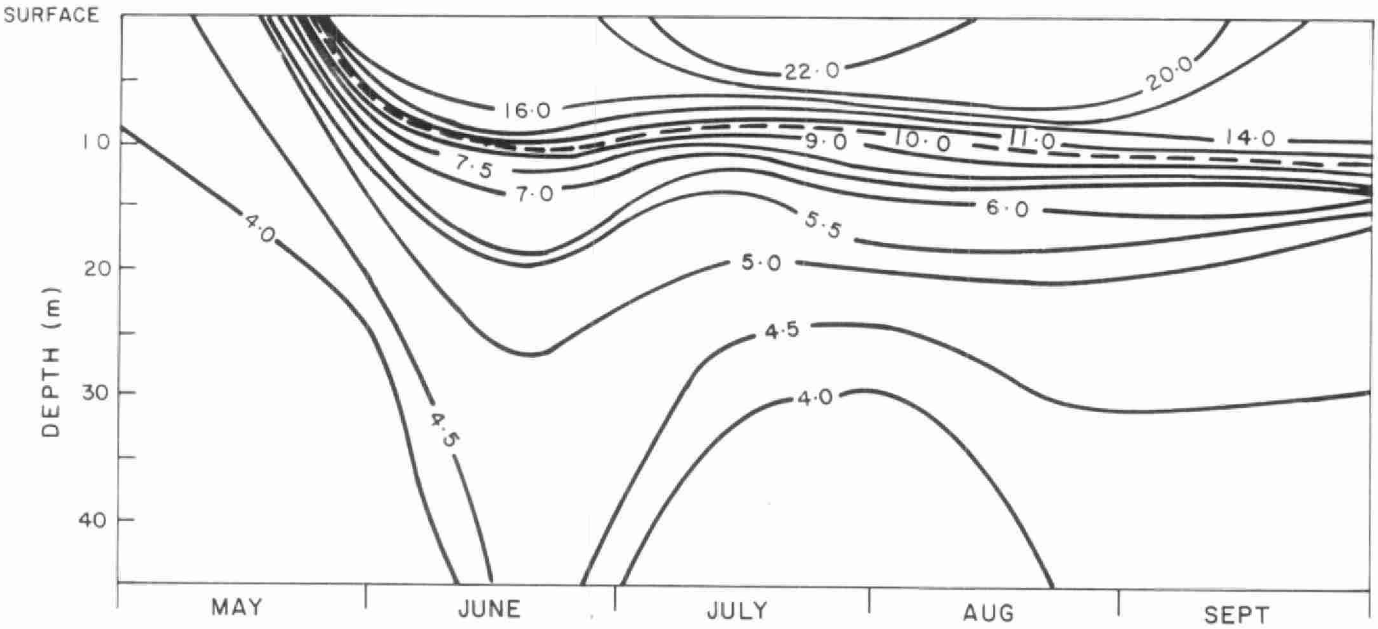

Figure 8a : Lake of Bays 1978 Station 5 – Isotherms (°C)

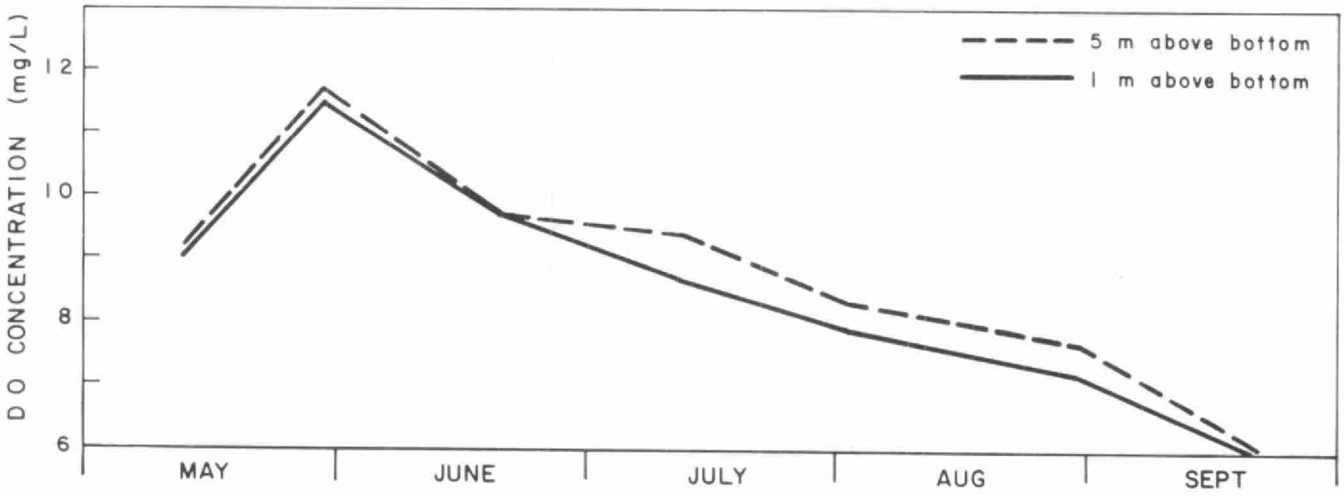

Figure 8b : Station 5 – Dissolved Oxygen Concentration (mg/L)

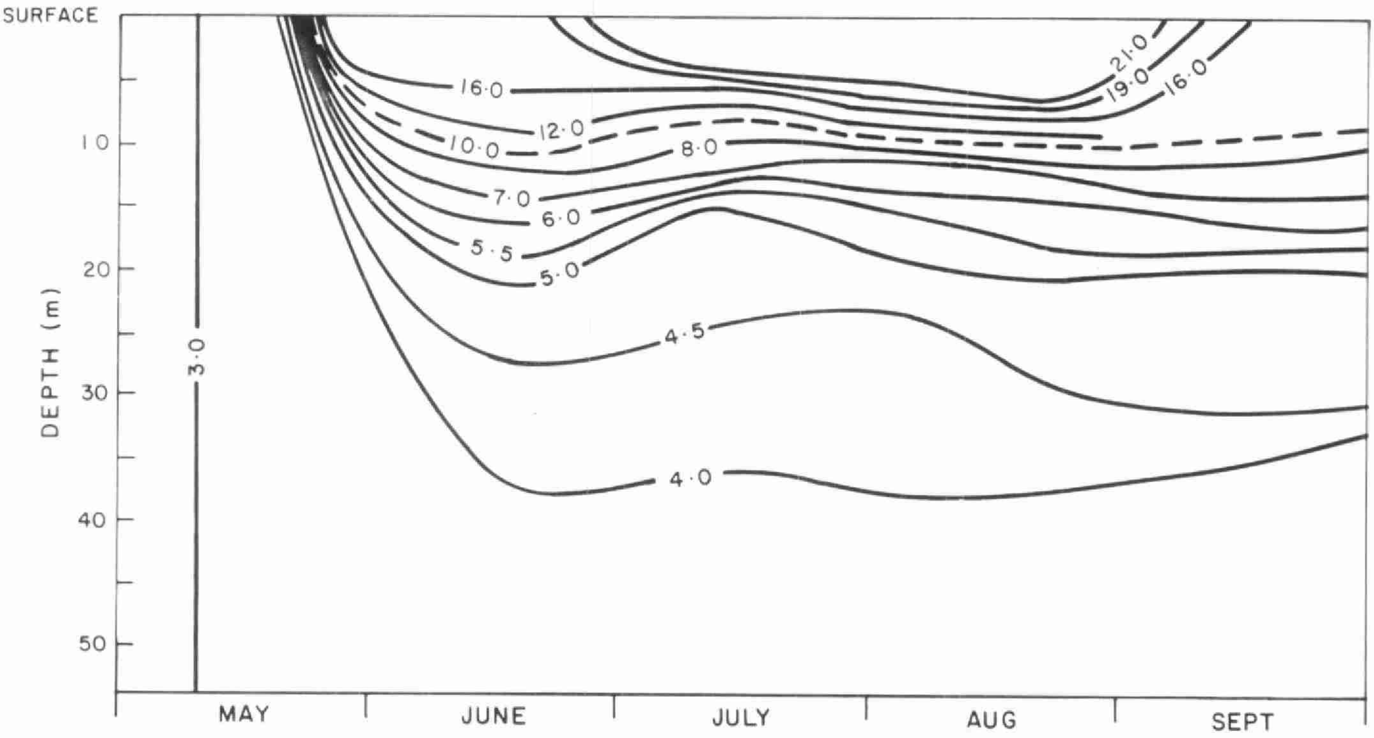

Figure 9a : Lake of Bays 1978 Station 6 — Isotherms (°C)

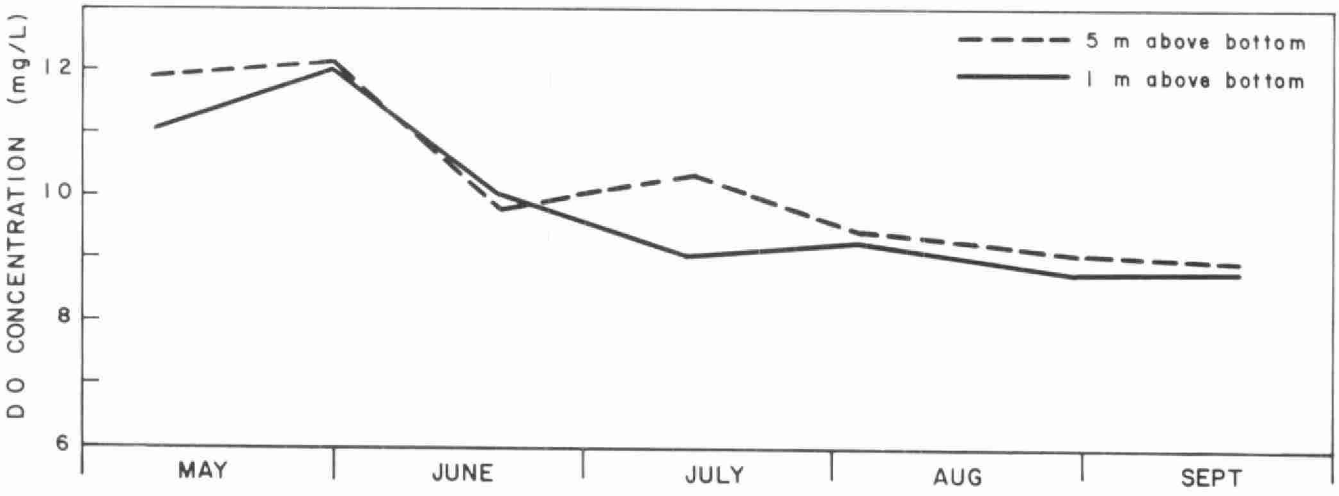

Figure 9b : Station 6 — Dissolved Oxygen Concentration (mg/L)

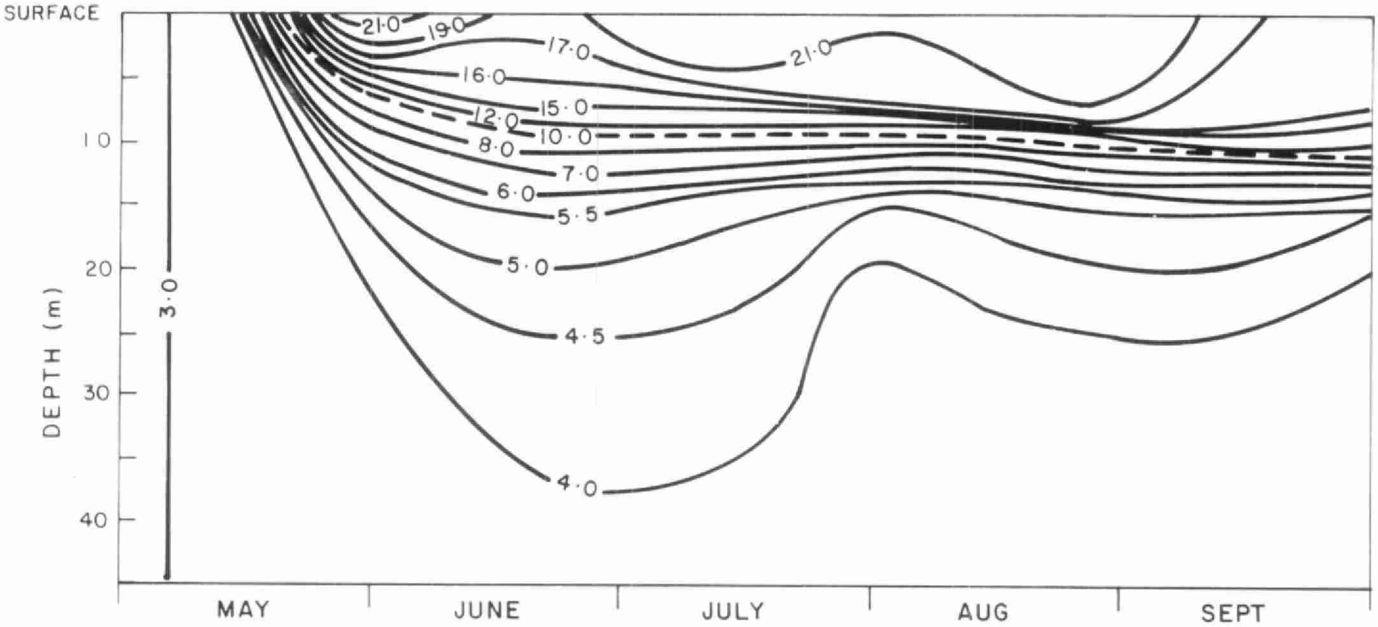

Figure 10b: Lake of Bays 1978 Station 7 – Isotherms (°C)

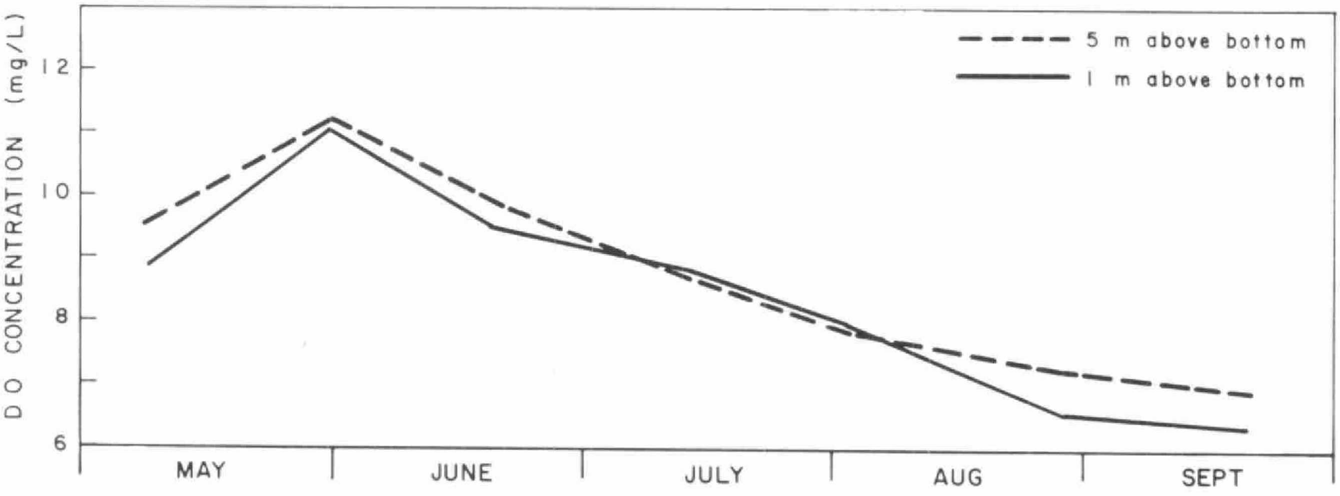

Figure 10b: Station 7 – Dissolved Oxygen Concentration (mg/L)

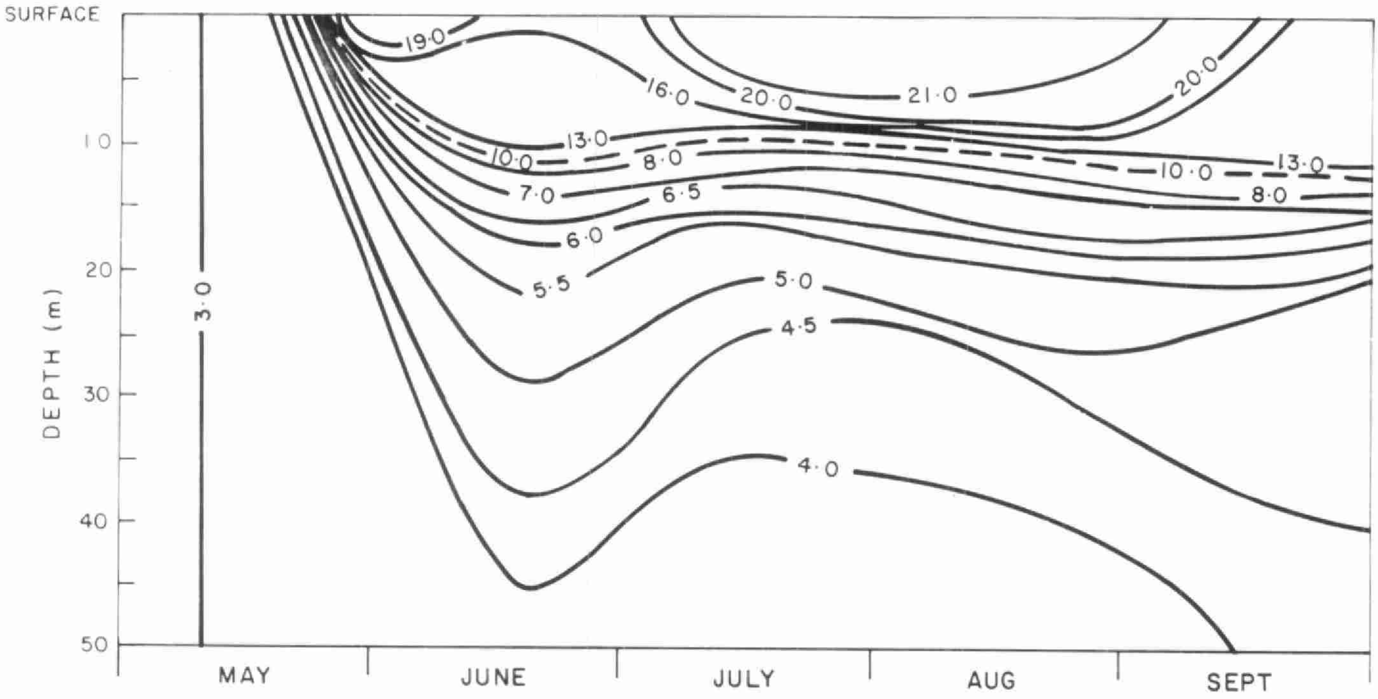

Figure 11a : Lake of Bays 1978 Station 8 – Isotherms (°C)

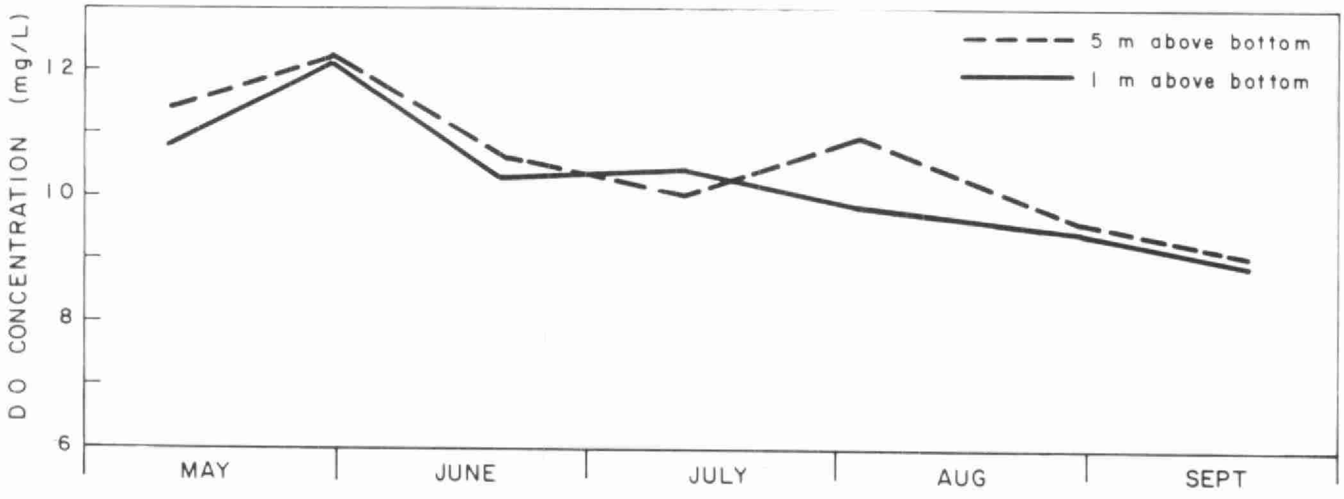

Figure 11b : Station 8 – Dissolved Oxygen Concentration (mg/L)

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